COLONY OF THE GAMBIA.

IMPERIAL BUREAU
4 OCT 1929
OF MYCOLOGY

THE ANNUAL REPORT

OF THE

DEPARTMENT OF AGRICULTURE

FOR THE YEAR 1928–9.

Price 5/-

PUBLISHED BY THE CROWN AGENTS FOR THE COLONIES
4, MILLBANK, LONDON, S.W.1.

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Assistant Director	*Vacant.*
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Caretaker Abuko	John Briggsman.

COLONY OF THE GAMBIA

DEPARTMENT OF AGRICULTURE

PLAN OF THE AGRICULTURAL AND BOTANICAL STATION CAPE ST MARY

SCALE OF FEET

100 50 0 100 200 300

AREA - 33·33 ACRES

ATLANTIC

OCEAN

GOVERNMENT HOUSE

T. WAELTER

← TO RESERVOIR

← TO BAKAU

DIRECTOR'S BUNGALOW

PLANT NURSERIES

KITCHEN GARDEN

A.E.T.C.

SUPERINTENDENTS BUNGALOWS

BANANAS

LABORATORIES & OFFICES

CITRUS

CITRUS

FUMIGATORIUM

COCOANUTS

STORE

QUARTER ACRE

EXPERIMENTAL

PLOTS

FRUIT

TRIAL

ORCHARD

PLOTS

BARRACKS

TO MASLUNGA

WIRELESS TELEGRAPH STATION

GROUND NUT

TRIAL PLOTS

← TO BAKAU

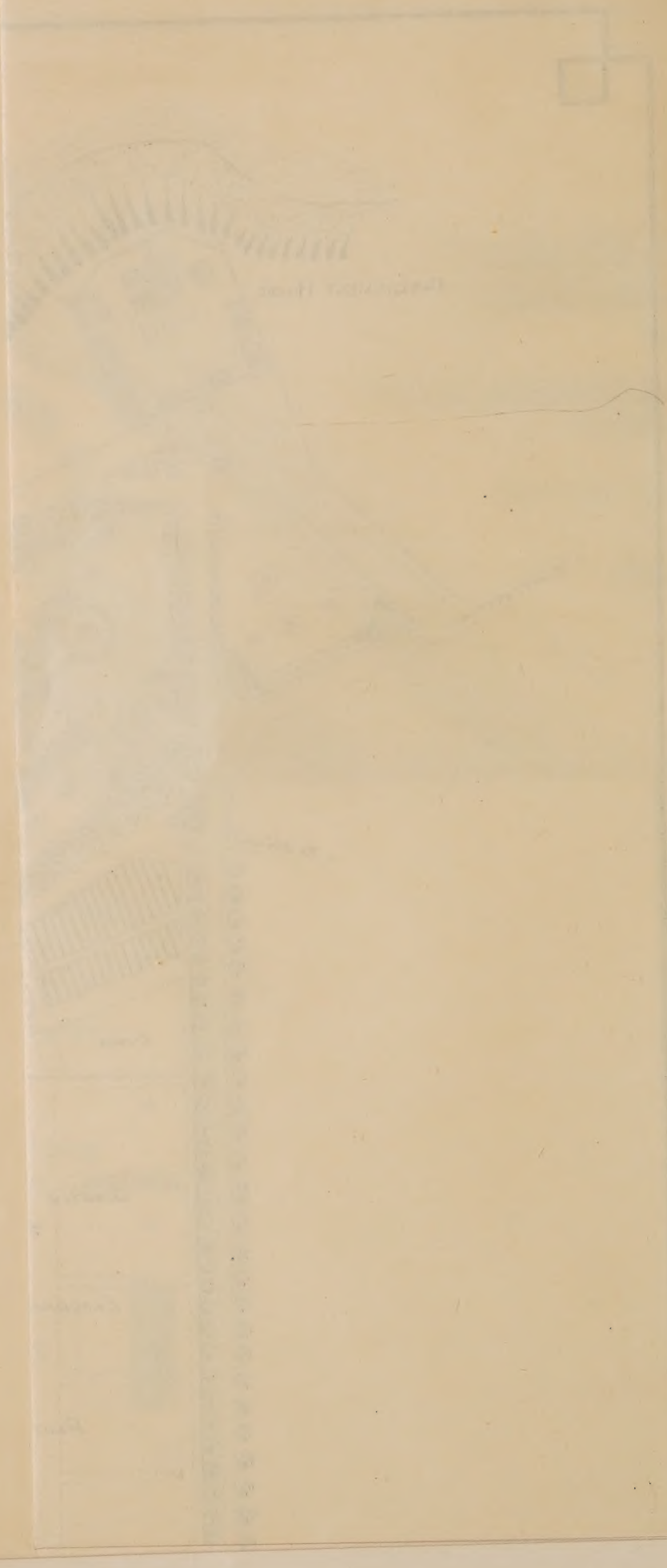
COCOANUTS

GROUND NUT

TRIAL PLOTS

SURVEYED BY L. HAGON. ASS. LAND OFFICER. OCT. 1928.

Land Officer & Surveyor



DEPARTMENT OF AGRICULTURE, THE GAMBIA.

REPORT

OF THE

DIRECTOR OF AGRICULTURE

FOR THE YEAR ENDED MARCH 31ST, 1929.

CLIMATIC CONDITIONS.

The climatic conditions throughout the growing season were favourable to all crops and particularly to groundnut cultivation. The total average annual rainfall for the whole Protectorate was 41·53 inches, this being 8·22 inches less than for the previous year which was abnormally high. The critical months are October and November when the groundnuts are ripening. In 1927 the total average rainfall for these two months was 8·51 inches and the quality of the groundnuts was seriously affected. In 1928 the total average rainfall for the same period was 4·09 and the groundnuts were of excellent quality.

The rainfall recorded in Bathurst was 56·99 but these figures are not taken into consideration in this report as no crops are grown in the town and they do not therefore affect the agricultural conditions. Outside Bathurst the highest rainfall in the year recorded was 55·95 at Sukuta and the lowest was 27·05 at Kuntaur.

Monthly records for each Province are given in the appendices.

THE AVERAGE MONTHLY RAINFALL THROUGHOUT THE PROTECTORATE FOR 1927 AND 1928 WAS AS FOLLOWS :—

	1927.	1928.	Decrease.	Increase.
May	2·57	0·68	1·89	—
June	4·98	2·55	2·43	—
July	5·73	8·00	—	2·27
August	16·37	14·53	1·84	—
September	11·59	11·68	—	0·09
October	7·35	3·49	3·86	—
November	1·16	0·60	0·56	—
Total	49·75	41·53	—	—

GENERAL AGRICULTURAL CONDITIONS.

Groundnuts.

The growing season 1928 was all that could be desired for the successful cultivation of groundnuts and the crop is of excellent quality, the percentage of bad kernels being considerably below that of last season. The average being ·67 as compared with 3·93 the previous season.

It is unfortunate that the European market for groundnuts should have been depressed at the time of the opening of the buying season on 1st December. The fluctuations of the market are not understood by the African farmer and it has so frequently happened that when the quality of the local groundnuts are exceptionally good the prices obtainable are below that of the season when the percentage of bad kernels was undoubtedly high. The teaching of the agricultural officers that a higher grade produce will command a higher price does not invariably work out in practice, indeed, during the last few seasons the reverse has actually been the case and sound agricultural teaching is therefore somewhat discredited in the African mind at the moment. The general depression at the opening of the buying season caused by the low prices ruling was considerably aggravated by the fact that quarantine precautions were in force owing to an outbreak of yellow fever. This considerably interfered with the general trade over the border and very few nuts came into the Gambia from French country. This depression continued throughout the buying season.

Crop 1928–29

The groundnut crop of 1928–29 although much superior to that of the previous year in quality was disappointing in quantity. It was not unreasonably expected in view of the favourable growing season and having due regard to the quantities of seed issued, that the anticipated crop would have been in the neighbourhood of 70,000 tons, thus maintaining the steady annual increase in production of the last few years. These hopes were not however realised, and the crop actually purchased was 57,505 tons. The shortage in crop was not confined to the Gambia but was general throughout the whole of French Senegal the yield per acre being below that of previous years. Many farmers made the mistake of sowing their nuts too soon. In numerous cases nuts were sown with the first showers of rain and before the soil had become thoroughly saturated. The nuts germinated well but did not survive the short spells of drought which followed the first showers and in these instances second and third sowings had to be made. The month of July is quite early enough for sowing groundnuts in any Province in the Gambia and much loss would be avoided by withholding sowing until then. This and similar errors have been dealt with in Bulletin No. 1 Groundnut Cultivation (With Special Reference to the Gambia) issued by this Department during the year. Another contributing factor to this reduction in output was the loss of 16,000 head of cattle from disease in the previous year. Motor lorries have in many districts replaced donkeys, and these animals are being rapidly sold over the border to enable the French farmers to carry their nuts to the railway line. This loss of animal life in a country which is entirely dependent upon animal manure for maintaining the fertility of the soil must have an adverse effect upon production.

Groundnut Prices.

The prices paid locally during the year ranged from 2s. 1d. to 2s. 4½d. These prices were as high as could reasonably be expected in view of the depressed market due largely to increased production in India. The native farmer cannot understand the fluctuation of market prices and having once been paid a high price for his nuts he is inclined to be discouraged if this price is not maintained. The Gambian farmer has become to expect nothing below 2s. 6d. a bushel for his produce

and this is in his mind at the time of sowing and he invariably sows only what he expects will yield him sufficient to meet his exact financial needs. If we examine the prices paid locally during the last thirty years we find that during the last decade the average price has been 2s. 10d. per bushel, the price during the previous decade was 1s. 10½d. and that paid during the first decade was only 1s. 6d. per bushel. The actual cost of production has not increased, but overhead charges have done so. Previously the African farmer was prepared to transport his nuts considerable distance by donkey or by head, to-day he demands that a motor lorry should fetch them from his farm. This service has to be paid for, either directly or indirectly and the farmer is not likely to benefit by the changed conditions. In a country like this where time is not an important economic factor donkey transport is the cheapest and best suited to the country. Modern progress is not always immediately advantageous in a primitive country and the following instances are perhaps worthy of record. Motor lorries which have replaced donkey transport have so speeded up transport generally that the trading season in the Protectorate has been shortened by about two months and it is very doubtful if the same bulk of trade in the sale of cotton goods is done in the shortened period.

Annual Export of Groundnuts.

The export figures for the last five years excluding Saboya nuts shipped through this Port are as follows :—

Year.	Tons.
1924	58,980
1925	46,583
1926	57,344
1927	65,107
1928	74,442

The steady increase of the last three years has unfortunately not been maintained. Exports of the 1928/9 crop are not yet completed, but the quantities actually purchased by each firm are available and these give a total tonnage of 57,505, showing a drop on the previous year of 16,937 tons.

Table Showing Quantity of Groundnuts Purchased in each Province, 1927/8 and 1928/9.

Province.	Groundnuts. Tons. 1927–8.	Groundnuts. Tons. 1928–9.	Increase.	Decrease.
Upper River	22,469	16,023	—	6,446
South Bank	14,954	10,892	—	4,062
Kombo and Fogni ...	10,591	11,361	770	—
North Bank	15,172	11,231	—	3,941
McCarthy Island ...	12,200	7,998	—	4,202
Total	75,386	57,505	770	18,651

PRODUCE INSPECTION.

The buying season for groundnuts opens each year on the 1st December and closes on the 30th April. Owing to the temporary shortage in staff it was not possible to give the same amount of supervision to this important work as formerly. Between four and five hundred screens were in operation at the various buying stations scattered along the three hundred miles of river.

The writer spent six weeks in January and February inspecting these stations and supervising the work of the native inspectors. Farmers in many instances are now deliberately mixing small stones and dried pieces of mud, know as "putter, putter," with their groundnuts. This is fast becoming an alarming practice and unless it is effectively stopped very serious results must follow. At almost every buying station during the present trading season labourers had to be employed in removing by hand this foreign matter. In one instance the writer removed 1 lb. 3 ozs. of dried mud from a standard bushel of groundnuts taken from a stack of several hundred tons at a wharf town.

Screening will not eliminate this adulteration, and it is impossible for the firms to remove the whole of it before buying as the congestion which this would cause at the buying stations would hold up the trade.

The farmers must be made to realise that such actions can only have one result, and that is to lower the prices paid for produce, and unless voluntary action is taken it may be necessary in the interests of the industry for Government to resort to further legislation.

STRANGE FARMERS.

The total number of Strange Farmers working in the Gambia in 1928 was 20,640, this being an increase of 3,403 over the previous year.

Their distribution was as follows :—

Province.	Actual Numbers.		1928.	Increase over previous year.
	1926.	1927.		
Upper River	5,389	5,498	7,154	1,656
McCarthy Island ...	1,068	1,665	2,097	432
South Bank	3,470	4,945	5,640	695
North Bank	1,253	2,229	2,644	415
Kombo and Fogni ...	2,373	2,900	3,105	205
Totals	13,553	17,237	20,640	3,403

The annual distribution of seed groundnuts and rice by the Government just previous to sowing time is a very important factor in the number of Strange Farmers attracted to the Gambia and the steady increase in their numbers is noteworthy.

GOVERNMENT GROUNDNUT SEED SUPPLY AND DEPOT SCHEME.

Seed Distributed, 1928–9.

The quality of selected seed distributed under this scheme during the year was 17,041 bags of four bushels and the distribution was as follows :—

Province.	Bags containing Four Bushels, 1928.
Upper River	5,690
South Bank	7,150
McCarthy Island	3,117
Kombo and Fogni	684
North Bank	400
Total	17,041

From the financial statement which follows it will be seen that this scheme appears to be a success. Experience has proved that native farmers cannot be depended upon to reserve sufficient seed for their own requirements, and to ensure progress in the annual production of groundnuts it is essential that the Government should issue a large portion of the seednuts required to raise the crop upon which the prosperity of the Colony depends. To avoid a repetition of the Government having to write off considerable sums through the failure of the farmers to meet their financial liabilities in this respect, this Distribution Scheme was drawn up two years ago and put into operation. Seed is sold to the farmers at a reasonable price which ensures a profit to the scheme. This profit is used to purchase seednuts for the following season, and if the same success is continued during the next two years the scheme will be entirely self-supporting and there will be an accumulated fund belonging to the native farmers of the Gambia of something in the neighbourhood of £12,000. The revenue of the Colony derives direct benefit from this scheme inasmuch as an export duty of 20s. per ton is levied on groundnuts. Interest at the rate of 5 per cent. is also paid to Government for the money at present being advanced for the purchase of seed out of the proceeds of sales of this seed.

Seed Nuts Distribution Scheme as at 31st March, 1929.

Expenditure.				Revenue.			
Particulars.	Amount.			Particulars.	Amount.		
	£	s.	d.		£	s.	d.
To 852 tons Ground Nuts purchased by Government, Season 1928–9	11,233	7	1	*By* Net Profit, Season 1927–8...	2,922	15	3
,, Bags Purchased by Government, Season 1928–9 ...	872	16	0	,, Value of Bags in Stock ...	274	3	4
,, Cost of Distribution : Porterage, Interest, etc., Season 1928–9	456	0	1	,, Seed Nuts supplied during Season 1928–9 :—			
				Repaid	15,173	3	0
				Outstanding	163	15	0
,, Balance at the end of Season 1928–9	5,971	13	5				
	£18,533	16	7		£18,533	16	7

Selected Seed in Store for 1929–30 Distribution.

The following quantities of selected seed have been stored for the coming season and will be distributed as follows :—

Province.	Four Bushel Bags.
South Bank	8,500
Upper River	6,500
McCarthy Island	4,000
Kombo and Fogni	430
North Bank	400
Total	19,830

NATIVE FOOD CROPS.

Increased areas were devoted to the production of food crops particularly in the Upper River and McCarthy Island Provinces. Good crops of rice, maize and millet were harvested. Guines corn suffered in some localities where the rainfall was insufficient to control the Aphids but in others fair crops were reaped.

Palm Kernels.

A slight falling off is shown in the export of palm kernels during 1928 but the quantity exported is only slightly below that of the average for the previous five years.

These exports are as follows :

Year.	*Tons.*	*Value.*
1924	678	£10,571
1925	692	12,254
1926	676	11,293
1927	719	11,611
1928	615	9,595

Oil Palm Reserve.

Steps are being taken to create a natural reserve in the Oil Palm belt in the Kombo district. Within the reserve the tapping of the palms for wine will be strictly prohibited and the palms cared for. Efforts are being made to obtain from Sumatra seed of the Delhi variety with a view to establishing a plantation with this and other varieties in this reserve.

Citrus Cultivation.

Special attention is being devoted to the development of a local trade in citrus and other fruits. The Washington Navel and Jaffa orange plants imported from the West Indies have made good growth and are setting fruit for the first time this year. West Indian limes planted at the various seed farms in the Protectorate have made excellent growth and clearly demonstrate the possibility of this crop if the native farmer can be induced to take up a permanent crop. To test the shipping qualities of the Gambia orange a consignment of two standard cases of fruit

was carefully prepared and shipped to Covent Garden Market, London. The following satisfactory report has been received from Geo. Monro, Limited :—

" I beg to acknowledge your letter of the 3rd of May, with reference to two cases of Oranges.

" These arrived quite safely and in excellent condition. No. 1 case was very high quality indeed, No. 2 good quality, the skin being thicker and coarser : the colour was pale which is a disadvantage, our public preferring a deep coloured orange.

" Oranges being short for a few days, we were enabled to get 30s. a case which must not be taken as their commercial value : that would be, in quantity, 18s. to 20s.

" We consider the fruit very suitable for supplying steamers as it is above the average in quality. We note you could not work up an export trade owing to absence of irrigation.

" We have pleasure in enclosing you account sale and remittance."

It is not anticipated that an extensive export trade can be developed, but there is no apparent reason why a substantial and profitable local industry should not be built up by supplying Bathurst and the ships calling there with fresh fruit.

CATTLE DISEASE.

Several outbreaks of cattle disease occurred in various parts of the Protectorate during the year. Arrangements have been made for a Veterinary officer from Nigeria or the Gold Coast to pay a visit to the Gambia in July or August. In the meantime, Dr. Harrison, of the Medical Department working in co-operation with Dr. Innes of the Board of Health is making Post Mortem examinations of cattle which have died from this disease. Affected organs are being removed and preserved for later examination by an expert veterinary. Clinical symptoms of infected animals at the various stages of their illness are also being recorded with a view to a correct diagnosis of the disease. At present there is some doubt as to whether the disease is Cattle Plague or Contagious Bovine Pleuro-Pneumonia and this must be definitely settled before preventive measures can be adopted.

Hides.

The export figures for hides show a drop of 11,688 below that of the previous year. This drop is largely due to the less frequent attacks of cattle disease. The figure is, however, much too high as these figures reflect the losses due to disease rather than an increase in the normal consumption of meal. The average number of hides exported for the five years period 1922–6 was 9,523. The average for the last two years during which period disease has been prevalent throughout the Protectorate is 22,472.

ROSETTE DISEASE INVESTIGATIONS.

A full account of the investigations in hand were given in my Annual Report for 1927–8, pages 11 to 16. These have been continued during the year now under review.

Insect Vectors.

In April, some two or three months previous to the sowing of groundnuts, a search for insects visiting groundnuts which had over-wintered in the ground from the previous season was undertaken by the writer. Three species of Leaf-hoppers were collected and forwarded to the Imperial Bureau of Entomology.

In due course Dr. Guy Marshall reported that Mr. W. E. China, of the British Museum, had described two of the species which belong to *Cicadulina* as being new to science and the little green *Empoasca* has not yet been determined. The official description is as follows :—

RHYNCHOTA.

Jassidae.

Cicadulina arachidis, China, sp.n.
Cicadulina similis, China, sp.n.
Empoasca sp.

Disease Resistant Varieties.

A number of field experiments were again conducted to determine the degree of resistance of certain varieties grown under the same conditions. The following varieties were experimented with :—Basse, Philippine Pink, Philippine White, Baol, Joal, Cayor, Senegal, Sine, Natal, Java White, Virginia Runner, Virginia Bunch, Valencia, Jumbo, Improved Spanish, Mauritius, Coanage and Spanish. Of these, Basse, Philippine Pink and Philippine White again showed a marked degree of resistance.

A supply of these three varieties have been forwarded to the Mycologist-in-Charge, Natal Herbarium, Durban, South Africa, with a view to their being submitted to further tests under South African conditions. Supplies have also been sent to Nigeria, Uganda and India.

A three-acre plot of Philippine Pink remained entirely free from infection, while an adjoining plot of the Senegal variety was badly infected.

The Natal, Improved Spanish and Jumbo gave very promising results, while the Senegal and Zaria varieties were heavily infected.

IMPORTED VARIETIES OF GROUNDNUTS.

The work in connexion with field trials of various imported varieties of groundnut was continued during the year.

Samples of seventeen of these varieties were forwarded to the Imperial Institute for examination and report as to their commercial value. Ten of these varieties, viz. : Valencia, Jumbo, Virginia Bunch, Improved Spanish, Coanage, Sine, Natal, Virginia Runner and Java White had not been previously tested. Among these new varieties there are two outstanding varieties—Natal and Improved Spanish, both of these produced over 80 per cent. kernel as compared with 74 per cent. of the Senegal variety. If this character is maintained the question of " lightness " of Gambia nuts as compared with those of Senegal will be solved.

In each case the oil content was also above the recognised trade standard of 37 per cent., being 38·5 per cent. in the case of the Natal variety, and 38·7 in that of the Improved Spanish. Another variety of great promise in so far as its field characters are concerned, such as yield and resistance to disease, is Coinage, but its oil content is at present somewhat low and its excess of shell rather high. The detailed report from the Imperial Institute is published as an appendix to this Report. Further varieties have been received from India and China and these will be included in the next field trials.

GAMBIA SOIL SURVEY.

A good deal of investigational work has been undertaken by the Department in connexion with soil fertility. From our field trials and observations made throughout the Protectorate it was obvious that Gambia soils were very deficient in organic matter, lime and phosphorus. In a country like this where it has been the practice of generations to clear the land by burning, the problem of building up the organic matter is difficult of solution. Experiments with Adco have been conducted, but while good results have been obtained under skilled supervision at some of our own farms its use can hardly be extended generally to native holdings. The growing of special green dressing crops followed by a suitable rotation appears to be the only solution at present, and this does not appeal to the native farmer whose practice is to shift his farm from place to place.

Manurial Trials.

Manurial trials conducted over a number of years have clearly demonstrated the necessity of devising some means of raising the organic content of the soil. Surface mulching is impracticable as the rain period is not of sufficient duration to enable it to rot down. Mulching as a soil cover to afford protection from exposure to the sun during the dry season—October to June—is very beneficial and strongly recommended.

Uniform Soil Survey of Africa.

The question of undertaking a uniform soil survey of Africa received consideration at the Imperial Agricultural Research Conference and at the West African Agricultural Conference held at Ibadan. Work in connexion with this survey in the Gambia was commenced in 1928 and fifty-eight soil samples have been collected and forwarded for examination. The Imperial Institute has undertaken the determination of these soils and their report on the first group of 15 samples forms an appendix to this Report. During the year under review the writer had the opportunity of going over the farm at Cape St. Mary with Dr. F. J. Martin, Agricultural Chemist, Sierra Leone, and of discussing with him a number of soil problems. In reviewing the determinations made by the Imperial Institute on this first group of soils, Dr. Martin records as follows :—

3. " *Lateritic properties.*—None of the soils are definitely lateritic in composition (see my definition *J. of Agric. Sc.*, 1927, vol. 17, p. 530), but one, overlying lateritic gravel very nearly approaches a lateritic condition. The silica alumina ratio is less than 2·0 in all lateritic soil clays, the ratio in your soils varies from 2·0 to 2·2, in Sierra Leone soils from 1·0 to 2·0, in Gold Coast soils from 1·8 to 2·8, in Nigeria 2·1 to 2·8 and Belgian Congo 1·9 to 2·6. So far as the chemical composition of the clay fraction is concerned your soils more closely resemble soils found in other parts of the West Coast than those of Sierra Leone."

4. " *Organic Matter.*—This is low in Gambia soils, varying from 0·56 to 0·94 per cent. This should be compared with from 2·0 to 4·0 per cent. in Sierra Leone, 1·0 to 2·0 per cent. in Gold Coast, 1·2 to 3·0 per cent. in Southern Nigeria, 0·6 to 0·8 per cent. in Northern Nigeria, and from 0·5 to 5 per cent. in Belgian Congo."

5. " *Nitrogen.*—Nitrogen is low in a manner similar to the Organic Matter."

6. " *Potash.*—This is low but is similar to the amount we found in Sierra Leone soils. A much higher potash content is found in Gold Coast, Nigeria and some Belgian Congo soils. Other soils from the Congo have the same low potash content."

7. "*Phosphorus.*—Your phosphorus figures are the lowest I have yet met except in one or two cases in the Belgian Congo."

8. "*Calcium.*—Like most soils on the West Coast your soils are low in calcium."

9. "On the whole, your soils are not well supplied with plant food, and I should think your problem is how to get organic matter and perhaps phosphorus into the soil, in fact, that was obvious from the plot of millet you showed me on the Cape Farm, the soil of which I should like to examine."

10. "A point which will interest you, if you do not already know it, is that in spite of poor soil the Gambia agricultural exports per head of population compare very favourably with other parts of the West Coast. The actual figures which I recently got out with reference to another matter are as follows :—

Colony.	*Agricultural Exports per Head of Population.*
	£
Gold Coast (including Ashanti and Northern Territories) ..	4.5
Gambia	4.0
Sierra Leone	1.0
Nigeria .. .. less than	1.0

These figures are only approximate of course but they should be of some satisfaction to the Gambia."

11. "An interesting point about manuring is that we have only had really good results on semi-permanent plantations such as citrus and coffee, we have had comparatively little response from Annual crops such as rice and groundnuts."

These remarks confirm the conclusions which we had arrived at, that the low organic and phosphorus content of the Gambia soils was the chief problem in maintaining fertility. Dr. Martin's concluding remarks in par. 11, are of particular interest as our experience in the Gambia has been the same.

CONTROL OF MALARIA BY THE CULTIVATION OF CLOVER.

The comparative immunity of the Argentine and Egypt from malaria is considered by some authorities to be due to the cultivation of sweet clover. The flowers are said to be visited by mosquitoes which feed upon the juice which is a sugar syrup containing coumarin. The theory advanced is that the coumarin probably acts upon the infected mosquito as quinine does in man. This question is fully dealt with in a paper by Sir William Willcocks, K.C.M.G., Formerly Director General of Reservoir Studies, Egypt. In concluding the paper referred to Sir William writes :—

"Malaria is such a terrible curse and its suppression over the face of any country by changing malignant malaria mosquitoes into benign ones would be such a blessing, that no one responsible for regions where malarial fevers are the common heritage of the people should find it possible to contemplate cultivated Egypt's immunity from malaria and shrug his shoulders and do nothing."

VIEW IN PLANT NURSERIES, CAPE ST. MARY.

VIEW IN BOTANIC GARDENS, CAPE ST MARY.

VIEW IN BOTANIC GARDENS, CAPE ST. MARY.

To test the possibilities of clover growing in the Gambia a quantity of seed of three species of clover was obtained from the United States Department of Agriculture, Washington. These were sown in nursery beds in August and good germination was obtained. Metilotus officinalis (Albotrea sweet clover); and M. indica made good growth and the former is now flowering profusely just at the period when the mosquitoes begin to get troublesome. Observations will be continued throughout the rains and it is hoped that mature seed will be harvested for further trials.

HYDNOCARPUS WIGHTIANA.

The plants raised from seed of *Hydnocarpus Wightiana* in 1926 have made good growth at the various seed farms where they were planted. A further batch of 109 strong plants have been raised from seed received from India in 1928 through the British Empire Leprosy Relief Association. From the nuts of this plant Chaulmoogra oil is obtained which is being so successfully used in the treatment of leprosy.

CAPE ST. MARY BOTANICAL GARDENS.

Included in this report is a plan showing the general lay-out of the land occupied by the Department at Cape St. Mary. The thanks of this Department are due to the Land Office for the able manner in which this plan has been prepared. The land has been divided into four main sections :—

(i) The Botanical Gardens.
(ii) Plant Nurseries.
(iii) Laboratories, Offices and Bungalows.
(iv) Field Plots.

Cape St. Mary is situated at the mouth of the river and is about eight miles from Bathurst to which it is connected by the only metalled road in the Colony.

The Botanical Gardens commenced in 1924 for the purpose of getting together an economic plant collection from which plants could be raised for general distribution and to provide an attractive garden for the enjoyment of residents in Bathurst, has made excellent progress and has become popular not only with local residents but with visitors from Overseas and from neighbouring Colonies.

In 1925 His Royal Highness The Prince of Wales planted a tree in these gardens and the following are among the distinguished visitors who have since paid them a visit: The Duke and Duchess of Sutherland, Sir Lionel Halsey, Sir Godfrey Thomas, Captain Dudley North, R.N., Captain The Honourable Piers Legh, Count and Countess Raben-Lewetzau, The Rt. Hon. W. G. A. Ormsby-Gore, M.P., The Rt. Hon. Major W. Elliott, M.P., Sir Henry Galway, Lady Byrne, Sir James and Lady Wilson, Sir Frederick and Lady Cleaver, Sir Samuel and Lady Wilson, Sir James Reynolds and His Excellency The Governor-General of French West Africa. In March last the gardens were visited by a large number of distinguished tourists from the R.M.S. "Arcadian" who were completing a tour of East and West Africa. They recorded their pleasure in no uncertain terms at finding a garden wherein they could rest and see a collection of tropical plants of economic value without undue fatigue. The appreciation felt by Overseas visitors upon visiting these gardens is ably expressed by Sir James Reynolds in an article published in Elder Dempster's Magazine for April which is as follows :—"There is one feature which Bathurst may justifiably claim with no little pride, and that is the Botanical Gardens and the breezy residences at the Cape. The gardens are really beautiful, and one is introduced at once to the wonderful tropical growths of West Africa. The absence of such gardens elsewhere on the Coast gives Bathurst a special pride of place."

NEW LABORATORIES AND OFFICES.

From photographs published in this report it will be seen that suitable accommodation and facilities have been provided for carrying on the technical work of the Department. The laboratory now permits of work involving chemical, entomological and mycological problems being conducted.

PROVINCIAL SEED FARMS.

Groundnut cultivation at these farms was reduced to a minimum during the year under review as part of the policy of following out certain rotations. Benni seed received special attention with a view to raising a good seed supply for general distribution. It is hoped to get this crop taken up more generally in the Protectorate. Special varieties of Guines corn were experimented with and a good supply of seed was harvested for distribution. Owing to the low fertility of the soil on some of these farms certain areas were fallowed throughout the year.

AGRICULTURAL EDUCATION AND TRAINING.

Armitage School.

Agricultural instruction continues to form an important part of the work of this school. The instruction which of necessity is very elementary is made as practical as possible and a good garden is maintained.

Government Vernacular School.

Through the efforts of the Governor, Sir Edward Denham, a Government Vernacular School has been established in buildings at the agricultural station. Cape St. Mary. This school is attended by children from the neighbouring towns of Bakau and Wasloonga. It also provides facilities for the education of the children of the men of the Gambia Company, Royal West African Frontier Force stationed at the Cape. Agriculture occupies an important place in the education of these children and daily instruction in the field is given by an officer of this Department. An acre of land adjoining the school has been set aside for the use of the children in which they are being taught to grow vegetables for their own consumption and for sale in Bathurst. This is a small beginning but it is hoped in due course to be able to obtain from this source suitable applicants for field assistants in the Agricultural Department.

Agricultural Show.

Arrangements are well advanced for the holding of an Agricultural Show in Bathurst in March next, at which it is hoped to be able to draw special attention to the possibilities of several crops worthy of receiving closer attention.

Training of Youths at Cape St. Mary.

A number of youths are being employed and trained in the plant nurseries at Cape St. Mary with a view to their becoming field assistants in the near future. Promising results are now being obtained and I hope to be able to report that satisfactory results have been attained in due course.

STAFF CHANGES.

Mr. C. W. Line, Assistant Director of Agriculture, proceeded on leave on 1st February and was transferred to the Gold Coast on 18th July. His successor has not yet been appointed.

FRONT VIEW, AGRICULTURAL LABORATORIES AND OFFICES.

SIDE VIEW, AGRICULTURAL LABORATORIES AND OFFICES.

OFFICERS' QUARTERS.

Mr. J. Pirie, Agricultural Superintendent, proceeded on leave on 2nd March and returned to the Colony on 17th August.

Mr. T. R. Hayes proceeded on leave on 14th July, and in October commenced a Refresher Course at the Imperial College of Tropical Agriculture, Trinidad, West Indies. This officer is still absent from the Colony.

Mr. J. W. Sparrow proceeded on leave on 17th November and returned on 30th March.

Agricultural Overseers Benjamin Cummings, Momadou Kater, Joseph Joh and Sanosi Camara were dismissed for incompetence and replaced by Baba Balde, Secku Camara and Secku Sarr.

CORRESPONDENCE AND DISTRIBUTION OF INFORMATION ON AGRICULTURAL MATTERS.

Registered communications numbering 1,112 were dealt with at the Director's office during the year. These included reports on various subjects, and 160 minute papers.

EXPENDITURE AND REVENUE, 1928.

The votes of the Department of Agriculture for the year under review were as follows :—

	Vote.	*Actual Expenditure.*		
	£	£	s.	d.
Personal Emoluments	4,289	3,709	11	8
Sea Passages	315	278	10	0
Transport and Travelling Allowances	630	473	12	2
Miscellaneous Requisites	190	93	8	4
Scientific Apparatus	100	84	12	9
Plants, Seeds, Fertilizers, Chemicals for plant disinfection	300	266	9	1
Labour	1,520	1,567	8	1
Technical Library	10	7	8	11
Tools, Implements and Machinery	50	53	6	1
Uniforms	85	26	10	4
One Motor Lorry	245	291	17	1
Planting of Trees, Bathurst	100	0	17	7
Fees, etc., of Superintendent at Imperial College of Agriculture	—	99	0	0

The total expenditure for the year was £6,952 12s. 1d., being £781 7s. 11d. below the approved estimate.

The revenue derived from sale of Plants and Seeds was £841 12s. 7d.

METEOROLOGY.

The following are summaries of the observations recorded at the Agricultural Station, Cape St. Mary, for the year ending 31st December, 1928 :—

Rainfall.—The rainfall for the year was 51·52 inches, being 25·51 inches below that of the previous year.

The first shower fell on 29th May, when ·29 inches was registered, and the last on 5th November, when 4·03 inches were registered. A heavy fall of rain at that period of the year is most unusual and caused considerable damage to the

groundnut crop which was then ripening. The annual rainfall for Bathurst for the years 1889–1928 are published in the appendices to this Report.

Wind.—The highest velocity of the wind recorded over a period of 24 hours was 18·51 miles per hour on 19th April. From January to May the wind blew from N.E. and N.W. During the months of June to October, it blew from S.W. and W., and from N.E. during November and December.

Temperature.—The mean maximum temperature for the year was 82·6°, being 2° below that for the previous year. The minimum was 70·6°, being 2° higher than the previous year. The hottest months of the year were June and October, when the average daily temperature was 80·3°. The extreme maximum temperature recorded on three occasions was 93° on 24th March, 7th June and 22nd September, this being 7° below that of the previous year. The extreme minimum 59° was recorded on 14th February, being 1° above that of the previous year.

Humidity.—The mean relative humidity for the year was 65·2 per cent., being 3·1 per cent. less than in 1927. The range being from 44 per cent. in February to 85 per cent. in July. The usual detailed Meteorological Report for 1928 is included in this Report.

METEOROLOGICAL REPORT FOR 1928.

Department of Agriculture, The Gambia.

Hours of Observation 9.00 a.m.

Station Cape St. Mary. 16° 40′ 24″ 13° 29′ 04″ H. 52.31.

Months.	Air Temperature.							Dry bulb temperature, 9.00 a.m.	Vapour Pressure.	Relative Humidity.	Wind velocity in miles per hour.	Rainfall. Ins.	No. of days in which rain fell.
	Means.			Absolute.									
	Max.	Min.	Mean.	Max.	Date.	Min.	Date.						
									inch				
January ...	82·1	64·3	76	89	19th	60	4th	71·1	0·409	53	6·7	—	—
February ...	81·2	64·2	73	91	14th	59	19th	71·7	0·336	44	6·8	—	—
March ...	79·1	66·4	73	93	24th	61	21st	73·1	0·443	54	10·2	—	—
April ...	77·1	67·1	70	83	7th	64	10th	73·2	0·534	66	11·8	—	—
May	81·1	69·2	76	86	20th	69	2nd	77·2	0·620	67	6·9	45	2
June ...	85·4	76·4	80	93	7th	69	1st	82·3	0·742	68	7·6	1·77	5
July	85·2	76·8	81	89	15th	70	9th	79·1	0·839	85	6·7	7·10	14
August ...	82·2	73·1	78	86	1st	65	3rd	79·1	0·793	80	3·5	25·88	28
September ...	85·7	74·1	80	93	22nd	70	7th	80·2	0·820	80	4·4	12·62	19
October ...	86·1	76·8	81	90	1st	71	10th	82·1	0·785	72	4·7	4·24	9
November ...	85·8	72·1	79	91	3rd	68	27th	78·1	0·550	59	6·9	—	—
December ...	81·3	67·1	74	89	2nd	60	28th	73·2	0·443	54	7·41	—	—
Totals ...	992·3	847·6	918	1,073	—	786	—	920·4	7·314	782	77·13	56·06	77
Means ...	82·6	70·6	76·6	89·5	—	65·6	—	76·7	0·609	65·2	6·42	—	—

Main Sea Level determined from readings taken at gauge, Bathurst, over periods January 1st to December 31st, 1927.

CONCLUSION.

I desire to record my thanks to the following Directors whose Departments have rendered valuable assistance to us during the year under review: Royal Botanic Gardens, Kew; Imperial Bureaux of Mycology and Entomology; Imperial Institute; Departments of Agriculture, Sierra Leone, Gold Coast and Nigeria.

The year under review has proved a particular difficult one for several reasons. The most important being, perhaps, the tremendous change in the economic situation along the French border which was brought about by quarantine restrictions just as the trading season opened. The loss of the services of two of my four European officers due to one being transferred to another Colony after arrangements had already been made to send another for a Refresher Course to the Imperial College of Tropical Agriculture, Trinidad.

Under these exceptional circumstances I desire to express my sincere thanks to all members of my staff both African and European for the extra assistance which they have loyally rendered throughout the year. The period now under review may, I venture to state, be rightly regarded as one during which there has been a very earnest and full investigation of our agricultural resources and possibilities by His Excellency the Governor, supported by the Travelling Commissioners and the officers of this Department. This coupled with the practical co-operation which I have received from all the firms trading in the Gambia enables me to look forward with confidence to a more successful trading season in 1929–30.

(Sgd.) ARCHIBALD J. BROOKS,

Director.

June 12th, 1929.

APPENDICES.

WORK CONDUCTED AT THE IMPERIAL INSTITUTE DURING THE YEAR 1928 FOR THE GAMBIA.

Plant and Animal Products Department.

Economic Investigations and Enquiries.

During 1928 the following investigations were carried out for the Gambia.

Samples of eight varieties of groundnuts, viz., Mauritius, Basse, Gambia, Philippine White, Philippine Pink, Senegal, Baol and Zaria, were forwarded by the Director of Agriculture. It was stated that the rainfall at the station where the nuts were grown had been abnormally high and that it was desired to ascertain the effect of this on the quality of the nuts.

The results of the investigation showed that all the samples contained normal percentages of oil, the yield from the Philippine Pink nuts being lower than that from the other varieties. The acidity of the oils was satisfactorily low in the Mauritius, Basse, Philippine Pink, Senegal and Baol varieties. In the other three cases the amount of free fatty acids present in the oil slightly exceeded 2 per cent. which is usually regarded as the limit for undecorticated groundnuts of "good merchantable quality."

A comparison with the results obtained in 1927 for seven of the above-mentioned varieties showed that in the present samples the kernels formed a higher proportion of the total weight of the nuts, and that in most cases the kernels were larger and yielded more oil, but that the oils contained a slightly higher percentage of free fatty acids.

A further sample representing Senegal groundnuts purchased on the French boundary, was found to include 22 per cent. of nuts with mouldy, defective or discoloured kernels. The kernels contained a normal amount of oil, but the acidity of the oil was excessive owing to the poor condition of the sample.

Publications.

The following articles of special interest to the Gambia were published during the year in the "Bulletin of the Imperial Institute":—

"Recent Research on Empire Products."

Mineral Resources Department.

Economic Investigations and Inquiries.

Soils.—15 soils from the Gambia, consisting of four sets of top soils with the accompanying subsoils to depths of 2, 3 and 4 feet, were examined at the Imperial Institute during 1928. All the top soils were very sandy, but in a few of the subsoils the amount of clay present increased with depth.

The soils on the whole were of poor quality and would need good supplies of water and organic matter. Liming was also needed to correct the marked acidity of the soils, but after this treatment, they would appear to be well suited to the cultivation of groundnuts.

Public Exhibition Galleries.

Gambia Court.

There has been no change in the area or site of Court.

No exhibits or photographs have been received for exhibition during the year.

Photographs to illustrate scenery, crops and life of the people for window transparencies are now being required in order to keep the Court up to date, and to bring it into line with the adjoining Courts of Nigeria and the Gold Coast which are now undergoing extensive improvements as a result of special grants from the Government concerned.

The lectures to organised parties from schools have been continued during the year : also the distribution of specimens of products, literature and postcards relating to the Gambia.

The public attendance in the Galleries during the year was 345,961. Displays of Empire films in the Cinema Theatre of the Institute have continued daily throughout the year. This Cinema was equipped and is maintained by the Empire Marketing Board.

During the year 1928, 214,830 persons attended the displays of over six thousand films. There were 500 displays of films specially relating to the scenery, life and industries of West Africa.

REPORT ON GROUNDNUTS FROM THE GAMBIA.

The 17 samples of groundnuts which are the subject of this Report were forwarded to the Imperial Institute by the Director of Agriculture and are referred to in his letter No. Ag. B. 28/1929 of the 3rd January, 1929.

It was stated that the samples represented varieties of groundnuts grown by the Department in a season favourable to groundnut cultivation, the rainfall being much less than in the previous year.

Description.

The samples all consisted of undecorticated groundnuts, and were as follows :—

Variety.	Weight. Lb.	Nuts.	Kernels.
Zaria ...	1¾	Mostly containing 2 kernels; many only 1. The nuts measured from ½ to 1½ inch (mostly ¾ to 1 inch) in length, and ⅜ to ½ inch in diameter.	Fairly plump. Size, small to large; 7 per cent. defective.* Skins, pinkish brown.
Valencia ...	3½	Mostly containing 2 or 3 kernels; a few with 1 or 4. The nuts measured from ¾ to 1¾ inch (mostly 1¼ inch) in length, and ½ inch in diameter.	Plump. Size, medium to large. Skins, dark red.
Joal	2½	Mostly containing 2 kernels; some only 1. The nuts measured from ½ to 1 inch (mostly ¾ to 1 inch) in length, and ⅜ to ½ inch in diameter.	Plump. Size, medium. Skins, pale pink.
Jumbo ...	3¼	Mostly containing 2 kernels; a few only 1. The nuts measured from ¾ to 2 inch (mostly 1½ inch) in length, and ⅝ inch in diameter.	Plump. Size, very large. Skins, pale pink.
Virginia Bunch	3¾	Mostly containing 2 kernels; a few only 1. The nuts measured from ¾ to 1¾ inch (mostly 1¼ inch) in length, and ½ inch in diameter.	Plump. Size, large. Skins, pinkish brown.
Philippine White	2	Mostly containing 2 kernels, some 1 or 3. The nuts measured from ½ to 1½ inch (mostly ¾ to 1¼ inch) in length, and ½ inch in diameter.	Plump. Size, medium to large.; 7 per cent. defective.* Skins, greyish cream.
Mauritius ...	3¼	Mostly containing 2 kernels; some only 1. The nuts measured from ½ to 1½ inch (mostly 1 inch) in length, and ⅜ to ½ inch in diameter.	Lacking in plumpness. Size, small to large. 10 per cent. defective.* Skins, pinkish brown.
Improved Spanish	4¼	Mostly containing 2 kernels. The nuts measured from ⅝ to 1¾ inch (mostly 1 to 1¼ inch) in length, and ½ inch in diameter.	Plump. Size, medium to large. Skins, pale pinkish brown.
Basse ...	1¾	Mostly containing 2 kernels; some only 1. The nuts measured from ½ to 1¼ inch (mostly ¾ to 1 inch) in length, and ½ inch in diameter.	Mostly lacking in plumpness. Size small to medium. 16 per cent. defective.* Skins, pale pink.

* Shrivelled or undeveloped kernels are included under "defective."

Variety.	Weight. Lb.	Nuts.	Kernels.
Coanage ...	2¼	Mostly containing 2 kernels; some only 1. The nuts measured ½ to 1½ inch (mostly ¾ to 1 inch) in length, and ½ inch in diameter.	Plump. Size, medium. 10 per cent. defective.* Skins, pinkish brown.
Sine	2½	Mostly containing 2 kernels; some only 1. The nuts measured from ½ to 1¼ inch (mostly ¾ to 1 inch) in length, and ⅜ to ½ inch in diameter.	Fairly plump. Size small. 4 per cent. defective.* Skins, pinkish brown.
Natal... ...	2½	Mostly containing 2 kernels; the nuts measured from ¾ to 1½ inch. (mostly ¾ to 1 inch) in length, and ⅜ to ½ inch in diameter.	Plump. Size, medium. Skins, pinkish brown.
Baol	2½	Mostly containing 2 kernels; many only 1. The nuts measured from ½ to 1¼ inch (mostly from ¾ to 1 inch) in length, and ⅜ inch in diameter.	Lacking in plumpness. Size, small to large. 7 per cent defective.* Skins, pinkish brown.
Philippine Pink ...	2¼	Mostly containing 2 kernels; some only 1. The nuts measured from ½ to 1½ inch (mostly ¾ to 1 inch) in length, and ½ inch in diameter.	Plump. Size, medium. Skins, pale pink.
Virginia Runner	2	Mostly containing 2 kernels; a few only 1. The nuts measured from ¾ to 1½ inch (mostly 1¼ inch) in length, and ½ inch in diameter.	Plump. Size, large. 3 per cent. defective.* Skins, pinkish brown.
Senegal ...	2¼	Mostly containing 2 kernels; many only 1. The nuts measured from ½ to 1½ inch (mostly ¾ to 1 inch) in length, and ⅜ to ½ inch in diameter.	Lacking in plumpness. Size, small. 6 per cent. defective.* Skins, pinkish brown.
Java White ...	2¼	Mostly containing 2 kernels; a few 3. The nuts measured from ¾ to 1¾ inch (mostly 1¼ inch) in length, and ½ inch in diameter.	Plump. Size, large. Skins, pale pinkish brown.

* Shrivelled or undeveloped kernels are included under "defective."

The proportions of husk and kernel were as follows:—

Variety.	Husk.	Kernel.
	Per cent.	Per cent.
Zaria	30·8	69·2
Valencia	23·0	77·0
Joal	21·0	79·0
Jumbo	25·0	75·0
Virginia Bunch	23·8	76·2
Philippine White	28·8	71·2
Mauritius	31·3	68·7
Improved Spanish	19·5	80·5
Basse	32·0	68·0
Coanage	30·3	69·7

Proportions of husk and kernel, etc.—*contd.*

Variety.	Nuts.	Kernels.
	Per cent.	Per cent.
Sine	22·3	77·7
Natal	19·8	80·2
Baol	25·8	74·2
Philippine Pink	22·3	77·7
Virginia Runner	22·5	77·5
Senegal	26·0	74·0
Java White	21·5	78·5

Results of Examination.

Kernels.—The kernels were examined with the following results :—

Variety.	Average weight of kernels.	Moisture in kernels.	Yield of Oil.		
			Expressed on kernels as received.	Expressed on moisture-free kernels.	Expressed on entire nuts.
	Grams.	Per cent.	Per cent.	Per cent.	Per cent.
Zaria	0·35	5·2	46·7	49·3	32·3
Valencia	0·47	5·6	46·7	49·5	36·0
Joal	0·42	5·0	49·9	52·5	39·4
Jumbo	0·93	5·4	48·9	51·7	36·7
Virginia Bunch	0·69	5·3	49·4	52·2	37·6
Philippine White	0·43	5·0	47·9	50·4	34·1
Mauritius	0·36	5·1	46·6	49·1	32·0
Improved Spanish	0·62	5·2	48·1	50·7	38·7
Basse	0·34	4·9	46·1	48·5	31·3
Coanage	0·42	5·0	48·2	50·7	33·6
Sine	0·39	5·1	49·4	52·1	38·4
Natal	0·48	5·7	48·0	50·9	38·5
Baol	0·35	5·0	48·1	50·6	35·7
Philippine Pink	0·49	5·0	48·2	50·7	37·4
Virginia Runner	0·66	5·0	49·4	52·0	38·3
Senegal	0·33	5·3	47·8	50·5	35·4
Java White	0·70	5·6	47·9	50·7	37·6

Oil.—The oils, extracted with light petroleum, were chemically examined, with the following results :—

Variety.	Acid value.	Free fatty acids (expressed as oleic acid).
		Per cent.
Zaria	1·4	0·70
Valencia	0·6	0·30
Joal	0·4	0·20
Jumbo	0·7	0·35
Virginia Bunch	0·3	0·15
Philippine White	1·1	0·55
Mauritius	0·4	0·20
Improved Spanish	0·6	0·30
Basse	0·5	0·25
Coanage	0·4	0·20
Sine	0·3	0·15
Natal	1·2	0·60
Baol	0·8	0·40
Philippine Pink	0·3	0·15
Virginia Runner	0·3	0·15
Senegal	1·0	0·50
Java White	1·4	0·70

REMARKS.

All the samples were in good clean condition. The kernels from the Jumbo variety were the largest; those of the Improved Spanish, Java White and Philippine Pink varieties were also of large size, and were very plump and of excellent appearance. The Senegal kernels were the smallest and had the poorest appearance.

The Basse nuts contained 16 per cent. of defective kernels; the Mauritius and Coanage, 10 per cent.; the Baol, Philippine White and Zaria, 7 per cent.; and the Senegal 6 per cent.

The percentages of husk in the nuts ranged from 19·5 in the Improved Spanish to 32·0 in the Basse variety. In addition to the last-mentioned, the Mauritius, Zaria and Coanage nuts also contained more than 30 per cent. of husk.

The percentage of oil in the kernels was normal in all cases, varying from 46·1 in the Basse variety to 49·9 in the Joal variety. When calculated on the

undecorticated nuts, the percentage of oil varied from 31·3 in the Basse to 39·4 in the Joal nuts. Undecorticated ground-nuts usually contain about 37 per cent. of oil.

The oil extracted from the kernels were in every case of normal appearance and of satisfactorily low acidity.

Of thes 17 varieties comprising the present series, seven have been examined previously at the Imperial Institute, viz., Zaria, Philippine White, Mauritius, Basse, Baol, Philippine Pink and Senegal. Comparison of the results obtained for these varieties in the present series with those of the previous series (see Imperial Institute Report, dated 30th April, 1928) shows that in every case the extracted oil has a lower acidity in the present series. It will be observed, however, that, with the exception of the Philippine Pink variety, the present samples contained more husk, smaller kernels and less oil than the corresponding varieties in the earlier series

16*th April*, 1929.

REPORT ON 15 SOILS FROM THE GAMBIA.

The samples dealt with in this Report were sent to the Imperial Institute by the Acting Director of the Department of Agriculture of the Gambia and referred to in his letter Ag.S.S. 966/1927 of 27th September, 1927.

The soils were sent in order that they might be submitted to a complete analysis and report.

The samples received were as follows :—

Nos. 713 to 716 from Sukuta Agricultural Farm which had been reclaimed from the bush two years ago and has now a crop of groundnuts.

Nos. 717 to 720 were taken at the Agricultural Station, Cape St. Mary and were stated to carry a crop of groundnuts and sorghums.

Nos. 187 to 190 from Kerewan Farm, North Bank Province, from old land upon which groundnuts and koose had been raised.

Nos. 191 to 193 were from Kansala Farm, in Kombo and Fogni Province. The soil, which is stated to bear a crop of groundnuts, is underlain by a lateritic rock at 3 feet from the surface.

The results of the chemical and mechanical analyses of the samples are shown in the attached schedules :

Reference : No. 720. Agricultural Station, Cape St. Mary. 1st twelve inches.

Description : A reddish brown, sandy soil.

PRELIMINARY MECHANICAL ANALYSIS OF THE ENTIRE SOIL, WHICH WAS AIR-DRIED BEFORE EXAMINATION.

	Size of Particles in mm.	Per cent.
Stones	Over 3	0·13
Gravel	3·0 to 1·0	0·55
" Fine earth "	Under 1·0	99·32

MECHANICAL ANALYSIS OF " FINE EARTH."

	Size of Particles in mm.	Fractions dried at 105° C.	Fractions ignited.
		Per cent.	Per cent.
Coarse sand	1·0 to 0·2	69·46	69·38
Fine sand	0·2 to 0·04	23·56	23·53
Silt	0·04 to 0·01	3·67	3·38
Fine silt	0·01 to 0·002	0·33	0·35
Clay	0·002 and under ...	2·70	2·30
Moisture at 105° C.		0·29	0·29
Matter soluble in water‡		0·03	0·03
Loss by solution in HCl		0·09	0·09
Organic matter lost by treatment with H_2O_2		0·45	—
Calcium carbonate		Nil	Nil
Loss on ignition*		—	0·99
Total		100·58	100·34

* Not including moisture at 105° C. or CO_2 from carbonates.

‡ Containing sulphates equivalent to sulphuric anhydride (SO_3) ... 0·014 per cent.
‡ Containing chlorides equivalent to chlorine (Cl) ... ... 0·002 per cent.

Reaction of soil: Acid, pH value 5·61.

Chemical Analysis of "Fine Earth."

		Soluble in Hydrochloric Acid.	Available constituents i.e., Portion Soluble in 1 per cent. Citric Acid Solution.		Exchangeable bases (Hissink method).
		Per cent.	Per cent.	Lb. per Acre.	Per cent.
Lime	CaO	0·05	0·030	1,337	0·029
Magnesia	MgO	0·06	0·009	401	0·012
Potash	K_2O	0·035	0·003	134	0·002
Soda	Na_2O	0·057	0·008	357	0·009
Ferric oxide ...	Fe_2O_3	0·63	—	—	0·001
Alumina	Al_2O_3	0·83	—	—	
Phosphoric acid ...	P_2O_5	0·024	0·013	579	—
Silica	SiO_2	—	—	—	—

		Total.	
		Per cent.	Lb. per Acre.
Nitrogen	N	0·026	1,159
Organic carbon ...	C	0·32	14,262
Organic matter* ...		0·58	—
Carbon dioxide ...	CO_2	Nil	—

* Obtained by multiplying the figure for organic carbon by $\frac{100}{55}$.

The figures for lb. per acre of the various constituents in the above table are calculated for a depth of 12 inches of soil, the apparent specific gravity of the soil being taken into consideration.

Atomic ratio $\begin{cases}\text{Carbon,} \\ \text{Nitrogen,}\end{cases} \frac{C}{N} = 14 \cdot 36.$

Composition of Clay Fraction (0·002 mm. and under, separated by sedimentation).

		Per cent.
Silica	SiO_2	37·06
Alumina	Al_2O_3	29·69
Ferric oxide	Fe_2O_3	9·19
Titanium dioxide	TiO_2	1·14
Manganous oxide	MnO	0·22
Lime	CaO	0·88
Magnesia	MgO	0·87
Potash	K_2O	0·50
Soda	Na_2O	0·38
Loss on ignition		20·28
Total		100·21

Molecular ratio $\begin{cases}\text{Silica,} \\ \text{Alumina,}\end{cases} \frac{SiO_2}{Al_2O_3} = 2 \cdot 12.$

Reference : No. 719. Agricultural Station, Cape St. Mary. 2nd twelve inches.

Description : A reddish brown, sandy soil.

PRELIMINARY MECHANICAL ANALYSIS ON THE ENTIRE SOIL, WHICH WAS AIR-DRIED BEFORE EXAMINATION.

—	Size of Particles in mm.	Per cent.
Stones	Over 3	Nil
Gravel	3·0 to 1·0	0·58
"Fine earth"	Under 1·0	99·42

MECHANICAL ANALYSIS OF "FINE EARTH."

—	Size of Particles in mm.	Fractions dried at 105° C.	Fractions ignited.
		Per cent.	Per cent.
Coarse sand	1·0 to 0·2	68·88	68·81
Fine sand	0·2 to 0·04	22·73	22·69
Silt	0·04 to 0·01	3·25	3·25
Fine silt	0·01 to 0·002	1·32	1·32
Clay	0·002 and under ...	3·63	2·88
Moisture at 105° C.		0·27	0·27
Matter soluble in water‡		0·02	0·02
Loss by solution in HCl		0·08	0·08
Organic matter lost by treatment with H_2O_2		0·24	—
Calcium carbonate		Nil	Nil
Loss on ignition*		—	0·85
Total		100·42	100·17

* Not including moisture at 105° C. or CO_2 from carbonates.

‡ { Containing sulphates equivalent to sulphuric anhydride (SO_3) ... 0·013 per cent.
‡ { Containing chlorides equivalent to chlorine (Cl) ... 0·002 per cent.

Reaction of soil : Strongly acid, pH value 4·84.

Reference : No. 718. Agricultural Station, Cape St. Mary. 3rd twelve inches.

Description : A reddish brown, sandy soil.

PRELIMINARY MECHANICAL ANALYSIS ON THE ENTIRE SOIL, WHICH WAS AIR-DRIED BEFORE EXAMINATION.

—	Size of Particles in mm.	Per cent.
Stones	Over 3	Nil
Gravel	3·0 to 1·0	0·27
"Fine earth"	Under 1·0...	99·73

MECHANICAL ANALYSIS OF "FINE EARTH."

—	Size of Particles in mm.	Fractions dried at 105° C.	Fractions ignited.
		Per cent.	Per cent.
Coarse sand	1·0 to 0·2	66·41	66·33
Fine sand	0·2 to 0·04	23·76	23·74
Silt	0·04 to 0·01	4·13	4·03
Fine silt	0·01 to 0·002	1·25	0·82
Clay	0·002 and under ...	3·75	3·13
Moisture at 105° C.		0·22	0·22
Matter soluble in water‡		0·02	0·02
Loss by solution in HCl		0·07	0·07
Organic matter lost by treatment with H_2O_2		Nil	—
Calcium carbonate		Nil	Nil
Loss on ignition*		—	0·89
Total		99·61	99·25

* Not including moisture at 105° C. or CO_2 from carbonates.

‡ Containing sulphates equivalent to sulphuric anhydride (SO_3) ... 0·016 per cent.
‡ Containing chlorides equivalent to chlorine (Cl) ... ... 0·002 per cent.

Reaction of soil : Strongly acid, pH value 4·73.

Reference : No. 717. Agricultural Station, Cape St. Mary. 4th twelve inches.

Description : A reddish brown, sandy soil.

PRELIMINARY MECHANICAL ANALYSIS ON THE ENTIRE SOIL, WHICH WAS AIR-DRIED BEFORE EXAMINATION.

——	Size of Particles in mm.	Per cent.
Stones	Over 3	Nil
Gravel	3·0 to 1·0	0·26
"Fine earth"	Under 1·0	99·74

MECHANICAL ANALYSIS OF "FINE EARTH."

——	Size of Particles in mm.	Fractions dried at 105° C.	Fractions ignited.
		Per cent.	Per cent.
Coarse sand	1·0 to 0·2	63·35	63·29
Fine sand	0·2 to 0·04	25·65	25·12
Silt	0·04 to 0·01	5·03	4·77
Fine silt	0·01 to 0·002	1·52	1·33
Clay	0·002 and under	4·73	4·10
Moisture at 105° C.		0·17	0·17
Matter soluble in water‡		0·02	0·02
Loss by solution in HCl		0·05	0·05
Organic matter lost by treatment with H_2O_2		Nil	—
Calcium carbonate		Nil	Nil
Loss on ignition*		—	1·01
Total		100·52	99·86

* Not including moisture at 105° C. or CO_2 from carbonates.

‡ { Containing sulphates equivalent to sulphuric anhydride (SO_3) ... 0·013 per cent.
‡ { Containing chlorides equivalent to chlorine (Cl) ... ... 0·002 per cent.

Reaction of soil : Strongly acid, pH value 4·60.

The soils from the Agricultural Station, Cape St. Mary, are all of a very sandy character. It is seen from the mechanical analysis that the coarse and fine sand fractions constitute over 90 per cent. of the soil, the fine sand being about a third of the coarse in the two upper soils and slightly more in the lower. The silt and clay fractions are low so that the soil obviously needs an abundant supply of water for cultivation.

There is very little change in the physical condition with increasing depth, but a slight increase in the silt and clay fractions can be traced. The fairly high ratio of alumina to silica is an important feature of the clay fraction. No calcium carbonate is present, and all the samples have an acid reaction which is less in the top than in the sub-soils. The water soluble matter is low and is the same for all the sub-soils. Very little organic matter is present.

The soil is poor in the principal plant food ingredients, especially in potash and nitrogen, and the lime, which is an important constituent from the point of view of the cultivation of groundnuts, is also inadequate. The amount of available phosphate is fairly satisfactory, but the reserve, as represented by the acid soluble phosphate, is low.

The exchangeable bases consist chiefly of lime, magnesia and soda with little potash alumina or ferric oxide.

The ratio of carbon to nitrogen is high, although not abnormally so for tropical soils. A carbon/nitrogen ratio of 15 has been reported (by Joseph) from the Sudan, although in temperate climates this ratio usually ranges from 10 to 12. Owing to the sandy nature of the soil and the character of the climate, the nitrogen from the humus is evidently being lost fairly rapidly.

Reference : No. 716. Sukuta Agricultural Farm. 1st twelve inches.

Description : A brown, sandy soil.

PRELIMINARY MECHANICAL ANALYSIS ON THE ENTIRE SOIL, WHICH WAS AIR-DRIED BEFORE EXAMINATION.

—	Size of Particles in mm.	Per cent.
Stones	Over 3	Nil
Gravel	3·0 to 1·0	0·44
"Fine earth"	Under 1·0	99·56

MECHANICAL ANALYSIS OF "FINE EARTH."

—	Size of Particles in mm.	Fractions dried at 105° C.	Fractions ignited.
		Per cent.	Per cent.
Coarse sand	1·0 to 0·2	46·45	46·40
Fine sand	0·2 to 0·04	37·65	37·60
Silt	0·04 to 0·01	7·45	7·23
Fine silt	0·01 to 0·002	1·53	1·60
Clay	0·002 and under ...	6·55	5·35
Moisture at 105° C.		0·35	0·35
Matter soluble in water‡		0·05	0·05
Loss by solution in HCl		0·07	0·07
Organic matter lost by treatment with H_2O_2		0·52	—
Calcium carbonate		Nil	Nil
Loss on ignition*		—	1·67
Total		100·62	100·32

* Not including moisture at 105° C. or CO_2 from carbonates.

‡ { Containing sulphates equivalent to sulphuric anyhdride (SO_3) ... 0·028 per cent.
‡ { Containing chlorides equivalent to chlorine (Cl) ... ... 0·001 per cent.

Reaction of soil : Acid, pH value 5·71.

Chemical Analysis of "Fine Earth."

		Soluble in Hydrochloric Acid.	Available constituents *i.e.*, Portion Soluble in 1 per cent. Citric Acid Solution.		Exchangeable bases (Hissink method).
		Per cent.	Per cent.	Lb. per Acre.	Per cent.
Lime	CaO	0·055	0·028	1,136	0·033
Magnesia	MgO	0·07	0·022	893	0·017
Potash	K_2O	0·020	0·003	122	0·003
Soda	Na_2O	0·018	0·005	203	0·008
Ferric oxide... ...	Fe_2O_3	0·59	—	—	0·002
Alumina	Al_2O_3	2·17	—	—	
Phosphoric acid ...	P_2O_5	0·007	0·001	41	—
Silica	SiO_2	—	—	—	—

		Total.	
		Per cent.	Lb. per Acre.
Nitrogen	N	0·039	1,582
Organic carbon ...	C	0·42	17,040
Organic matter* ...		0·77	—
Carbon dioxide ...	CO_2	Nil	—

* Obtained by multiplying the figure for organic carbon by $\frac{100}{55}$.

The figures for lb. per acre of the various constituents in the above table are calculated for a depth of 12 inches of soil, the apparent specific gravity of the soil being taken into consideration.

Atomic ratio $\left\{\frac{\text{Carbon, C}}{\text{Nitrogen, N}}\right. = 12·93.$

Composition of Clay Fraction (0·002 mm. and under, separated by sedimentation).

		Per cent.
Silica	SiO_2	41·13
Alumina	Al_2O_3	31·51
Ferric oxide	Fe_2O_3	5·94
Titanium dioxide	TiO_2	1·41
Manganous oxide	MnO	0·06
Lime	CaO	0·12
Magnesia	MgO	0·67
Potash	K_2O	0·60
Soda	Na_2O	0·26
Loss on ignition		18·43
Total		100·13

Molecular ratio $\left\{\frac{\text{Silica, } SiO_2}{\text{Alumina, } Al_2O_3}\right. = 2·22.$

Reference : No. 715. Sukuta Agricultural Farm. 2nd twelve inches.

Description : A light brown, sandy soil.

PRELIMINARY MECHANICAL ANALYSIS ON THE ENTIRE SOIL, WHICH WAS AIR-DRIED BEFORE EXAMINATION.

—	Size of Particles in mm.	Per cent.
Stones	Over 3	Nil
Gravel	3·0 to 1·0	0·41
"Fine earth"	Under 1·0	99·59

MECHANICAL ANALYSIS OF "FINE EARTH."

—	Size of Particles in mm.	Fractions dried at 105° C.	Fractions ignited.
		Per cent.	Per cent.
Coarse sand	1·0 to 0·2	43·12	43·07
Fine sand	0·2 to 0·04	39·16	39·10
Silt	0·04 to 0·01	6·33	6·38
Fine silt	0·01 to 0·002	2·17	2·12
Clay	0·002 and under ...	8·93	7·53
Moisture at 105° C.		0·38	0·38
Matter soluble in water‡		0·04	0·04
Loss by solution in HCl		0·08	0·08
Organic matter lost by treatment with H_2O_2		0·19	—
Calcium carbonate		Nil	Nil
Loss on ignition*		—	1·76
Total		100·40	100·46

* Not including moisture at 105° C. or CO_2 from carbonates.

‡ Containing sulphates equivalent to sulphuric anhydride (SO_3) ... 0·008 per cent.
‡ Containing chlorides equivalent to chlorine (Cl) ... ... 0·001 per cent.

Reaction of soil : Acid, pH value 5·05.

Reference : No. 714. Sukuta Agricultural Farm. 3rd twelve inches.

Description : A light brown soil containing a high percentage of clay.

PRELIMINARY MECHANICAL ANALYSIS ON THE ENTIRE SOIL, WHICH WAS AIR-DRIED BEFORE EXAMINATION.

—	Size of Particles in mm.	Per cent.
Stones	Over 3	Nil
Gravel	3·0 to 1·0	0·51
" Fine earth "	Under 1·0	99·49

MECHANICAL ANALYSIS OF " FINE EARTH."

—	Size of Particles in mm.	Fractions dried at 105° C.	Fractions ignited.
		Per cent.	Per cent.
Coarse sand	1·0 to 0·2	33·26	33·23
Fine sand	0·2 to 0·04	26·43	26·40
Silt	0·04 to 0·01	7·32	7·33
Fine silt	0·01 to 0·002	2·15	1·52
Clay	0·002 and under ...	29·48	25·93
Moisture at 105° C.		0·99	0·99
Matter soluble in water‡		0·03	0·03
Loss by solution in HCl		0·21	0·21
Organic matter lost by treatment with H_2O_2		Nil	—
Calcium carbonate		Nil	Nil
Loss on ignition*		—	4·64
Total		99·87	100·28

* Not including moisture at 105° C. or CO_2 from carbonates.

‡ Containing sulphates equivalent to sulphuric anhydride (SO_3) ... 0·015 per cent.
‡ Containing chlorides equivalent to chlorine (Cl) ... ... 0·002 per cent.

Reaction of soil : Acid, pH value 5·01.

Reference : No. 713. Sukuta Agricultural Farm. 4th twelve inches.

Description : A light brown soil containing a high percentage of clay.

PRELIMINARY MECHANICAL ANALYSIS ON THE ENTIRE SOIL, WHICH WAS AIR-DRIED BEFORE EXAMINATION.

	Size of Particles in mm.	Per cent.
Stones	Over 3	Nil
Gravel	3·0 to 1·0	0·61
"Fine earth"	Under 1·0	99·39

MECHANICAL ANALYSIS OF "FINE EARTH."

	Size of Particles in mm.	Fractions dried at 105° C.	Fractions ignited.
		Per cent.	Per cent.
Coarse sand	1·0 to 0·2...	31·07	31·03
Fine sand	0·2 to 0·04	27·49	27·47
Silt	0·04 to 0·01	7·10	6·43
Fine silt	0·01 to 0·002	2·08	2·15
Clay	0·002 and under ...	30·80	27·20
Moisture at 105° C.		1·01	1·01
Matter soluble in water‡		0·03	0·03
Loss by solution in HCl		0·12	0·12
Organic matter lost by treatment with H_2O_2		Nil	—
Calcium carbonate		Nil	Nil
Loss on ignition*		—	4·63
Total		99·70	100·07

* Not including moisture at 105° C. or CO_2 from carbonates.

‡ Containing sulphates equivalent to sulphuric anhydride (SO_3) ... 0·015 per cent.
‡ Containing chlorides equivalent to chlorine (Cl) ... ... 0·002 per cent.

Reaction of soil : Acid, pH value 5·09.

In the series of soils No. 716 from the Sukuta Agricultural Farm, there is a marked change in the physical character with increasing depth. The two top soils are sandy, containing over 80 per cent. of the fine and coarse sand fractions and less than 9 per cent. of clay. In the two lower soils the clay has increased to approximately 30 per cent. at the expense of the sand fractions. The amount of silt and fine silt remains fairly uniform throughout the series.

The analysis of the clay fraction ot the top soil shows a very high ratio of aluminia to silica. Calcium carbonate is absent and the soils all have an acid reaction, slightly lower in the top than in the sub-soils.

The amount of water soluble salts shows a slight decrease with increasing depth.

The soil is deficient in organic matter.

It is also very poor in plant food ingredients, the most marked shortage being in the phosphate, the amounts of which, both acid soluble and available, appear to be insufficient for satisfactory cultivation.

The nitrogen and potash present are low, especially in the case of the reserve or acid soluble potash. The lime, a good supply of which is important for the cultivation of the groundnut crop, is also low even for a sandy type of soil.

The exchangeable bases consist chiefly of lime, magnesia and soda with small amounts of potash, ferric oxide and alumina.

The ratio of carbon to nitrogen is high although it is distinctly lower than in the previous series (No. 720, etc.).

Reference : No. 187, Kerewan Farm, North Bank Province, 1st twelve inches.

Description : A reddish brown, sandy soil.

PRELIMINARY MECHANICAL ANALYSIS ON THE ENTIRE SOIL, WHICH WAS AIR-DRIED BEFORE EXAMINATION.

—	Size of Particles in mm.	Per cent.
Stones	Over 3	0·02
Gravel	3·0 to 1·0	0·26
"Fine earth"	Under 1·0	99·72

MECHANICAL ANALYSIS OF "FINE EARTH."

—	Size of Particles in mm.	Fractions dried at 105° C.	Fractions ignited.
		Per cent.	Per cent.
Coarse sand	1·0 to 0·2	44·75	44·68
Fine sand	0·2 to 0·04	45·26	45·21
Silt	0·04 to 0·01	3·55	3·28
Fine silt	0·01 to 0·002	2·05	1·65
Clay	0·002 and under ...	4·23	3·50
Moisture at 105° C.		0·28	0·28
Matter soluble in water‡		0·03	0·03
Loss by solution in HCl		0·08	0·08
Organic matter lost by treatment with H_2O_2		0·25	—
Calcium carbonate		Nil	Nil
Loss on ignition*		—	1·01
Total		100·48	99·72

* Not including moisture at 105° C. or CO_2 from carbonates.

‡ Containing sulphates equivalent to sulphuric anhydride (SO_3) ... 0·007 per cent.
‡ Containing chlorides equivalent to chlorine (Cl) ... ... 0·002 per cent.

Reaction of soil : Strongly acid, pH value 4·92.

Chemical Analysis of "Fine Earth."

		Soluble in Hydrochloric acid.	Available constituents *i.e.*, Portion Soluble in 1 per cent. Citric Acid Solution.		Exchangeable bases (Hissink method).
		Per cent.	Per cent.	Lb. per Acre.	Per cent.
Lime	CaO	0·042	0·012	526	0·009
Magnesia	MgO	0·045	0·015	658	0·004
Potash	K_2O	0·020	0·002	88	0·002
Soda	Na_2O	0·047	0·005	219	0·008
Ferric oxide... ...	Fe_2O_3	0·77	—	—	0·006
Alumina	Al_2O_3	1·28	—	—	
Phosphoric acid ...	P_2O_5	0·008	Trace	Trace	—
Silica	SiO_2	—	—	—	—

		Total.	
		Per cent.	Lb. per Acre.
Nitrogen	N	0·028	1,228
Organic carbon ...	C	0·30	13,159
Organic matter* ...		0·54	—
Carbon dioxide ...	CO_2	Nil	—

* Obtained by multiplying the figure for organic carbon by $\frac{100}{55}$.

The figures for lb. per acre of the various constituents in the above table are calculated for a depth of 12 inches of soil, the apparent specific gravity of the soil being taken into consideration.

Atomic ratio $\left\{\begin{matrix}\text{Carbon,}\\ \text{Nitrogen,}\end{matrix}\right. \frac{C}{N} = 12{\cdot}50.$

Composition of Clay Fraction (0·002 mm. and under, separated by sedimentation).

		Per cent.
Silica	SiO_2	37·57
Alumina	Al_2O_3	28·91
Ferric oxide	Fe_2O_3	10·08
Titanium dioxide	TiO_2	1·51
Manganous oxide	MnO	0·10
Lime	CaO	0·14
Magnesia	MgO	0·69
Potash	K_2O	0·52
Soda	Na_2O	0·34
Loss on ignition		20·59
Total		100·45

Molecular ratio $\left\{\begin{matrix}\text{Silica,}\\ \text{Alumina,}\end{matrix}\right. \frac{SiO_2}{Al_2O_3} = 2{\cdot}20.$

Reference : No. 188, Kerewan Farm, North Bank Province, 2nd twelve inches.

Description : A reddish brown, sandy soil.

PRELIMINARY MECHANICAL ANALYSIS ON THE ENTIRE SOIL, WHICH WAS AIR-DRIED BEFORE EXAMINATION.

—	Size of Particles in mm.	Per cent.
Stones	Over 3	Nil
Gravel	3·0 to 1·0	0·33
"Fine earth"	Under 1·0	99·67

MECHANICAL ANALYSIS OF "FINE EARTH."

—	Size of Particles in mm.	Fractions dried at 105° C.	Fractions ignited.
		Per cent.	Per cent.
Coarse sand	1·0 to 0·2	36·01	35·99
Fine sand	0·2 to 0·04	50·81	50·77
Silt	0·04 to 0·01	4·23	3·80
Fine salt	0·01 to 0·002	1·45	1·40
Clay	0·002 and under ...	6·55	5·68
Moisture at 105° C.		0·26	0·26
Matter soluble in water‡		0·02	0·02
Loss by solution in HCl		0·07	0·07
Organic matter lost by treatment with H_2O_2		Nil	—
Calcium carbonate		Nil	Nil
Loss on ignition*		—	1·36
Total		99·39	99·35

* Not including moisture at 105° C. or CO_2 from carbonates.

‡ { Containing sulphates equivalent to sulphuric anhydride (SO_3) ... 0·014 per cent.
‡ { Containing chlorides equivalent to chlorine (Cl) ... ... 0·002 per cent.

Reaction of soil : Strongly acid, pH value 4·79.

Reference : No. 189, Kerewan Farm, North Bank Province, 3rd twelve inches.

Description : A reddish brown, sandy soil.

PRELIMINARY MECHANICAL ANALYSIS ON THE ENTIRE SOIL, WHICH WAS AIR-DRIED BEFORE EXAMINATION.

—	Size of Particles in mm.	Per cent.
Stones	Over 3	Nil
Gravel	3·0 to 1·0	0·29
"Fine earth"	Under 1·0	99·71

MECHANICAL ANALYSIS OF "FINE EARTH."

—	Size of Particles in mm.	Fractions dried at 105° C.	Fractions ignited.
		Per cent.	Per cent.
Coarse sand	1·0 to 0·2	38·17	38·14
Fine sand	0·2 to 0·04	47·82	47·78
Silt	0·04 to 0·01	4·05	3·68
Fine silt	0·01 to 0·002	1·45	1·27
Clay	0·002 and under ...	7·78	6·88
Moisture at 105° C.		0·24	0·24
Matter soluble in water‡		0·02	0·02
Loss by solution in HCl		0·06	0·06
Organic matter lost by treatment with H_2O_2		Nil	—
Calcium carbonate		Nil	Nil
Loss on ignition*		—	1·54
Total		99·59	99·59

* Not including moisture at 105° C. or CO_2 from carbonates.

‡ Containing sulphates equivalent to sulphuric anhydride (SO_3) ... 0·012 per cent.

‡ Containing chlorides equivalent to chlorine (Cl) ... ... 0·001 per cent.

Reaction of soil : Strongly acid, pH value 4·73.

Reference : No. 190, Kerewan Farm, North Bank Province, 4th twelve inches.

Description : A bright red soil containing a high percentage of clay.

PRELIMINARY MECHANICAL ANALYSIS ON THE ENTIRE SOIL, WHICH WAS AIR-DRIED BEFORE EXAMINATION.

—	Size of Particles in mm.	Per cent.
Stones	Over 3	Nil
Gravel	3·0 to 1·0	0·52
"Fine earth"	Under 1·0	99·48

MECHANICAL ANALYSIS OF "FINE EARTH."

—	Size of Particles in mm.	Fractions dried at 105° C.	Fractions ignited.
		Per cent.	Per cent.
Coarse sand	1·0 to 0·2	34·01	33·96
Fine sand	0·2 to 0·04	35·40	35·35
Silt	0·04 to 0·01	3·05	3·10
Fine silt	0·01 to 0·002	1·75	1·75
Clay	0·002 and under ...	24·15	20·75
Moisture at 105° C.		0·71	0·71
Matter soluble in water‡		0·02	0·02
Loss by solution in HCl		0·08	0·08
Organic matter lost by treatment with H_2O_2		Nil	—
Calcium carbonate		Nil	Nil
Loss on ignition*		—	3·66
Total		99·17	99·38

* Not including moisture at 105° C. or CO_2 from carbonates.

‡ Containing sulphates equivalent to sulphuric anhydride (SO_3) ... 0·010 per cent.
Containing chlorides equivalent to chlorine (Cl) ... ... 0·002 per cent.

Reaction of soil : Strongly acid, pH value 4·86.

The three upper soils of the series No. 187 from Kerewan Farm, North Bank Province, are of a very sandy type, the coarse and fine sand fractions making up from 85 to 90 per cent. of the whole, and the clay fraction increasing from about 4 per cent. of the "fine earth" in the top soil to nearly 8 per cent. in the third. In the 4-ft. sample, on the other hand, the clay has increased to approximately 24 per cent. and the sand fractions have decreased.

In all cases more fine than coarse sand is present, tending to give some water-holding power to the soil. The amount of silt and fine silt remains fairly constant throughout the series.

The analysis of the clay fraction of the top soil shows a high ratio of alumina to silica.

The soils contain no calcium carbonate and all have a pronounced acidity.

Very little organic matter is present.

From a chemical standpoint the soil is of very poor quality and appears to be almost completely exhausted. The total supply of phosphate is inadequate, and practically none is present in the available condition. The potash and nitrogen are also very low.

The amount of lime is insufficient and a relatively small percentage is present in an easily available form as measured either by the amount "available" or by that present as "exchangeable base."

The exchangeable bases contain a fair proportion of ferric oxide and alumina in addition to the other bases.

The ratio of carbon to nitrogen is lower than in any other of the present series of soils.

Reference : No. 191, Kansala Farm, Kombo and Fogni Province, 1st twelve inches.

Description : A brown sandy soil.

PRELIMINARY MECHANICAL ANALYSIS ON THE ENTIRE SOIL, WHICH WAS AIR-DRIED BEFORE EXAMINATION.

—	Size of Particles in mm.	Per cent.
Stones	Over 3	0·10
Gravel	3·0 to 1·0	1·13
" Fine earth "	Under 1·0	98·77

MECHANICAL ANALYSIS OF " FINE EARTH."

—	Size of Particles in mm.	Fractions dried at 105° C.	Fractions ignited.
		Per cent.	Per cent.
Coarse sand	1·0 to 0·2	24·15	24·08
Fine sand	0·2 to 0·04	56·71	56·66
Silt	0·04 to 0·01	6·67	6·82
Fine silt	0·01 to 0·002	1·50	1·25
Clay	0·002 and under ...	9·33	7·85
Moisture at 105° C.		0·40	0·40
Matter soluble in water‡		0·03	0·03
Loss by solution in HCl		0·09	0·09
Organic matter lost by treatment with H_2O_2		0·35	—
Calcium carbonate		Nil	Nil
Loss on ignition*		—	2·29
Total		99·23	99·47

* Not including moisture at 105° C. or CO_2 from carbonates.

‡ { Containing sulphates equivalent to sulphuric anhydride (SO_3) ... 0·012 per cent.
‡ { Containing chlorides equivalent to chlorine (Cl) ... ... 0·002 per cent.

Reaction of soil : Acid, pH value 5·61.

Chemical Analysis of "Fine Earth."

	Soluble in Hydrochloric Acid.	Available constituents *i.e.*, Portion Soluble in 1 per cent. Citric Acid Solution.		Exchangeable bases (Hissink method).
	Per cent.	Per cent.	Lb. per Acre.	Per cent.
Lime ... ... CaO	0·065	0·041	1,743	0·044
Magnesia ... ... MgO	0·075	0·016	680	0·012
Potash ... ... K_2O	0·022	0·003	128	0·003
Soda ... ... Na_2O	0·032	0·004	170	0·007
Ferric oxide... ... Fe_2O_3	1·11	—	—	0·006
Alumina ... ... Al_2O_3	2·59	—	—	
Phosphoric acid ... P_2O_5	0·012	0·001	43	—
Silica ... ... SiO_2	—	—	—	—

	Total.	
	Per cent.	Lb. per Acre.
Nitrogen ... ... N	0·044	1,870
Organic carbon ... C	0·52	22,102
Organic matter* ...	0·94	—
Carbon dioxide ... CO_2	Nil	—

* Obtained by multiplying the figure for organic carbon by $\frac{100}{55}$.

The figures for lb. per acre of the various constituents in the above table are calculated for a depth of 12 inches of soil, the apparent specific gravity of the soil being taken into consideration.

Atomic ratio $\left\{\begin{matrix}\text{Carbon, } C \\ \text{Nitrogen, } N\end{matrix}\right. = 13·80.$

Composition of Clay Fraction (0·002 mm. and under, separated by sedimentation).

	Per cent.
Silica ... ... SiO_2	38·08
Alumina ... ... Al_2O_3	31·66
Ferric oxide ... ... Fe_2O_3	7·53
Titanium dioxide ... ... TiO_2	1·29
Manganous oxide ... ... MnO	Trace
Lime ... ... CaO	0·14
Magnesia ... ... MgO	0·57
Potash ... ... K_2O	0·46
Soda ... ... Na_2O	0·64
Loss on ignition	19·88
Total	100·25

Molecular ratio $\left\{\begin{matrix}\text{Silica, } SiO_2 \\ \text{Alumina, } Al_2O_3\end{matrix}\right. = 2·03.$

Reference : No. 192. Kansala Farm, Kombo and Fogni Province, 2nd twelve inches.

Description : A light brown soil containing a considerable amount of clay.

PRELIMINARY MECHANICAL ANALYSIS ON THE ENTIRE SOIL, WHICH WAS AIR-DRIED BEFORE EXAMINATION.

—	Size of Particles in mm.	Per cent.
Stones	Over 3	0·16
Gravel	3·0 to 1·0	1·18
"Fine earth"	Under 1·0	98·66

MECHANICAL ANALYSIS OF "FINE EARTH."

—	Size of Particles in mm.	Fractions dried at 105° C.	Fractions ignited.
		Per cent.	Per cent.
Coarse sand	1·0 to 0·2	17·17	17·12
Fine sand	0·2 to 0·04	47·53	47·48
Silt	0·04 to 0·01	5·40	5·38
Fine silt	0·01 to 0·002	2·65	2·67
Clay	0·002 and under ...	26·05	22·18
Moisture at 105° C.		0·72	0·72
Matter soluble in water‡		0·03	0·03
Loss by solution in HCl		0·12	0·12
Organic matter lost by treatment with H_2O_2		Nil	—
Calcium carbonate		Nil	Nil
Loss on ignition*		—	4·46
Total		99·67	100·16

* Not including moisture at 105° C. or CO_2 from carbonates.

‡ Containing sulphates equivalent to sulphuric anhydride (SO_3) ... 0·011 per cent.
‡ Containing chlorides equivalent to chlorine (Cl) ... ... 0·002 per cent.

Reaction of soil : Acid, pH value 5·32.

Reference : No. 193, Kansala Farm, Kombo and Fogni Province, 3rd twelve inches.

Description : A light brown soil containing a considerable amount of clay.

PRELIMINARY MECHANICAL ANALYSIS ON THE ENTIRE SOIL, WHICH WAS AIR-DRIED BEFORE EXAMINATION.

—	Size of Particles in mm.	Per cent.
Stones	Over 3	7·95
Gravel	3·0 to 1·0	1·82
"Fine earth"	Under 1·0	90·23

MECHANICAL ANALYSIS OF "FINE EARTH."

—	Size of Particles in mm.	Fractions dried at 105° C.	Fractions ignited
		Per cent.	Per cent.
Coarse sand	1·0 to 0·2	14·24	14·21
Fine sand	0·2 to 0·04	41·58	41·52
Silt	0·04 to 0·01	5·80	5·60
Fine silt	0·01 to 0·002	4·20	4·20
Clay	0·002 and under ...	33·65	28·68
Moisture at 105° C.		1·02	1·02
Matter soluble in water‡		0·02	0·02
Loss by solution in HCl		0·13	0·13
Organic matter lost by treatment with H_2O_2		Nil	—
Calcium carbonate		Nil	Nil
Loss on ignition*		—	5·26
Total		100·64	100·64

* Not including moisture at 105° C. or CO_2 from carbonates.

‡ Containing sulphates equivalent to sulphuric anhydride (SO_3) ... 0·015 per cent.
Containing chlorides equivalent to chlorine (Cl) ... ... 0·001 per cent.

Reaction of soil : Acid, pH value 5·35.

The soils from Kansala Farm, Kombo and Fogni Province, show a transition from the sandy surface soil to one containing a considerable clay fraction at a depth of three feet, the sand and silt fractions decreasing and the fine silt and clay fractions increasing with depth. The clay fraction of the top soil contains a high proportion of alumina relative to silica. No calcium carbonate is present and the soils all have an acid reaction. The acidity of these soils is slightly less than that of the other series examined, *i.e.*, No. 720 etc., 716 etc., 187 etc.

The amount of organic matter present in the surface soil is very low though slightly higher than the amount found in the other series.

The soil is of very poor quality chemically, especially as regards phosphate and potash. The nitrogen also appears to be insufficient, and the amount of lime is very low, though in both cases the quantities are rather higher than in the other series.

The exchangeable bases contain a fair proportion of alumina and ferric oxide in addition to the other bases.

The ratio of carbon to nitrogen is fairly high.

GENERAL REMARKS.

All these four soils with their respective sub-soils are very low in organic matter. The carbon/nitrogen ratio is higher than is normally the case with soils from temperate countries, but it appears to be well within the range found in tropical soils.

All the top soils are very sandy, but in certain cases (*e.g.*, Nos. 714 and 713, 190, 192, and 193) the clay fraction shows a marked increase with depth.

All the soils have an acid reaction and it is noteworthy that in each case the top soil is distinctly less acid than its sub-soils, although the sub-soils do not vary much among themselves.

The ratio of silica/alumina in the clay fraction is low in all cases, being only just over 2. This is particularly noticeable in soil No. 191, described as occurring over laterite rock, and this is as would be expected.

The mineral constituents of the soil are rather low, particularly the available phosphoric acid, except in soil No. 720. Among the acid soluble constituents, the magnesia slightly exceeds the lime in all cases, although as this relationship does not hold good for the " available " portions, it may not be of much importance.

On the whole, all these soils are of poor quality and would need good supplies of water and organic matter in particular.

RAINFALL RECORDED AT THE OFFICIAL RECORDING STATIONS THROUGHOUT THE COLONY AND PROTECTORATE DURING THE YEAR 1928.

Province.	Jan. to April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Totals.
Kombo and Fogni :—										
Bathurst	No rain	0·86	1·83	9·41	26·89	9·47	8·53	—	—	56·99
Cape St. Mary ...	,,	0·91	1·77	7·10	24·88	12·62	4·24	—	—	51·52
Sukuta	,,	0·38	2·52	9·42	25·24	12·24	6·15	—	—	55·95
Kansala	,,	0·89	2·42	13·96	19·48	9·24	5·91	—	—	51·90
Average for Province ...	No rain	0·76	2·13	9·97	24·12	10·89	6·20	—	—	54·09
North Bank :—										
Kerewan	No rain	0·90	1·17	10·09	17·95	10·24	5·64	—	—	45·99
South Bank :—										
Kudang	No rain	1·56	2·28	7·79	7·14	11·56	3·28	—	—	33·61
Soma	,,	0·87	1·88	10·56	19·12	9·44	3·89	—	—	45·76
Bansang	,,	—	1·69	5·28	10·84	14·83	2·71	0·38	—	35·73
Average for Province ...	No rain	1·21	1·95	7·87	12·36	11·94	3·29	0·38	—	38·36
McCarthy Island :—										
Kau-ur	No rain	0·45	2·76	4·47	12·18	11·33	2·43	—	—	33·62
Kuntaur	,,	0·40	2·24	4·35	5·13	12·69	2·24	—	—	27·05
Georgetown	,,	0·08	4·61	6·64	8·23	13·20	3·07	—	—	35·83
Lamin Koto	,,	1·35	3·20	7·40	9·56	11·86	3·15	—	—	36·52
Average for Province ...	No rain	0·57	3·20	5·71	8·77	12·27	2·72	—	—	33·25
Upper River :—										
Mansajang	,,	0·23	3·22	9·09	13·21	10·15	1·92	0·41	—	38·23
Wuli	,,	0·18	1·87	7·67	14·55	11·06	2·22	0·26	—	37·81
Fattoto	,,	—	4·14	8·22	15·75	13·08	2·01	1·36	—	44·56
Average for Province ...	No rain	0·20	3·07	8·32	14·50	11·43	3·05	0·67	—	40·20

ANNUAL RAINFALL, BATHURST, FOR THE YEARS 1889–1928, SHOWING AVERAGES FOR THE LAST FOUR DECADES.

	Inches.		Inches.
1889	32·06	1909	56·59
1890	60·31	1910	44·00
1891	53·41	1911	28·14
1892	51·13	1912	33·99
1893	77·89	1913	23·68
1894	55·86	1914	52·33
1895	66·86	1915	47·64
1896	51·18	1916	38·02
1897	33·61	1917	37·68
1898	48·65	1918	54·03
	—— 53·09 average.		—— 41·61 average.

1899	56·17	1919	39·23
1900	43·38	1920	34·29
1901	45·31	1921	35·12
1902	29·42	1922	45·71
1903	57·13	1923	65·38
1904	38·02	1924	56·46
1905	64·16	1925	44·09
1906	64·33	1926	35·05
1907	34·00	1927	60·58
1908	43·54	1928	56·99
	—— 47·54 average.		—— 47·29 average.

* TABLE SHOWING ANNUAL EXPORTS OF GROUNDNUTS FROM 1900 TO 1928.

Year.	Tons.	Value.
		£
1900	25,605	221,841
1901	25,750	172,405
1902	31,612	193,486
1903	45,477	275,394
1904	43,436	229,287
1905	29,499	169,426
1906	36,050	278,055
1907	40,858	256,685
1908	31,964	245,084
1909	53,644	323,231
1910	58,456	387,942
1911	47,931	437,472
1912	64,169	502,069
1913	67,404	622,079
1914	66,885	650,461
1915	96,151	400,434
1916	46,366	506,098
1917	73,300	869,790
1918	56,490	800,319
1919	71,677	1,172,843
1920	85,190	2,398,444
1921	59,175	628,901
1922	64,800	780,889
1923	64,178	864,885
1924	60,622	861,925
1925	48,700	693,097
1926	61,072	862,578
1927	69,240	967,941
1928	76,772	1,122,253

* Including groundnuts from Saboya.

NUMBER OF IMMIGRANT OR "STRANGE FARMERS" ENTERING THE GAMBIA ANNUALLY TO PLANT GROUNDNUTS.

Year.	Number.
1912	6,525
1913	9,940
1914	14,908
1915	32,220
1916	9,315
1917	20,727
1918	20,509
1919	22,440
1920	24,150
1921	22,048
1922	20,566
1923	17,383
1924	14,188
1925	14,652
1926	13,553
1927	17,237
1928	20,640

AVERAGE LOCAL PRICE PAID FOR GROUNDNUTS FOR THE LAST TWENTY-NINE YEARS.

Trade	1899–1900	...	Wharf Towns		1s. 6d.	...	...	...	Shipping Towns		1s. 9d.
,,	1900–1901	...	,,	,,	1s. 6d.	...	...	...	,,	,,	1s. 9d.
,,	1901–1902	...	,,	,,	2s.	...	...	...	,,	,,	2s. 3d.
,,	1902–1903	...	,,	,,	1s. 4d., 1s. 2d.	...	...		,,	,,	1s. 7d., 1s. 2d.
,,	1903–1904	...	,,	,,	1s.	...	...	...	,,	,,	1s. 3d.
,,	1904–1905	...	,,	,,	1s. 1d.	...	...	...	,,	,,	1s. 4d.
,,	1905–1906	...	,,	,,	1s. 3d.	...	...	...	,,	,,	1s. 6d.
,,	1906–1907	...	,,	,,	1s. 3d.	...	...	...	,,	,,	1s. 6d.
,,	1907–1908	...	,,	,,	1s. 9d.	...	...	...	,,	,,	2s.
,,	1908–1909	...	,,	,,	1s. 1d., 1s. 2d.	...	...		,,	,,	1s. 4d., 1s. 2d.
,,	1909–1910	...	,,	,,	1s. 4d.	...	...	...	,,	,,	1s. 7d.
,,	1910–1911	...	,,	,,	2s.	...	...	...	,,	,,	2s. 3d.
,,	1911–1912	...	,,	,,	1s. 6d.	...	...	...	,,	,,	1s. 9d.
,,	1912–1913	...	,,	,,	2s.	...	...	...	,,	,,	2s. 3d.
,,	1913–1914	...	,,	,,	2s. 1d.	...	...	...	,,	,,	2s. 4d.
,,	1914–1915	...	,,	,,	4d., 1s. 2d.		...	...	,,	,,	7d., 1s. 2d.
,,	1915–1916	...	,,	,,	1s. 10d., 1s. 2d.			...	,,	,,	2s. 1d., 1s. 2d.
,,	1916–1917	...	,,	,,	2s. 4d., 1s. 2d.	...	...		,,	,,	2s. 7d., 1s. 2d.
,,	1917–1918	...	,,	,,	2s. 6d.	...	...	...	,,	,,	2s. 9d.
,,	1918–1919	...	,,	,,	2s. 7d., 1s. 2d.	...	...		,,	,,	2s. 10d., 1s. 2d.
,,	1919–1920	...	,,	,,	5s. 3d.	...	...	...	,,	,,	5s. 6d.
,,	1920–1921	...	,,	,,	2s. 9d.	...	...	...	,,	,,	3s.
,,	1921–1922	...	,,	,,	2s. 3d.	...	...	...	,,	,,	2s. 6d.
,,	1922–1923	...	,,	,,	2s. 4d., 1s. 4d.	...	...		,,	,,	2s. 7d., 1s. 2d.
,,	1923–1924	...	,,	,,	2s. 5d.	...	...	...	,,	,,	2s. 8d.
,,	1924–1925	...	,,	,,	2s. 4½d.	...	...	...	,,	,,	2s. 9d.
,,	1925–1926	...	,,	,,	2s. 2¼d.	...	...	...	,,	,,	2s. 3¾d.
,,	1926–1927	...	,,	,,	2s. 6d.	...	...	...	,,	,,	2s. 7d.
,,	1927–1928	...	,,	,,	2s. 9d.	...	...	...	,,	,,	2s. 10½d.
,,	1928–1929	...	,,	,,	2s. 1d.	...	...	...	,,	,,	2s. 4½d.

NOTE.—The above prices are only an average for each trading season. For instance, in 1919–1920 as much as 8s. per bushel of 28 lbs. was paid, this being the highest price ever paid in the Gambia.

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